Themis: Research Journal of Justice Studies and Forensic Science

Volume 8 Article 3

5-2020

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Abstract

Lip prints have distinct forms of wrinkles and grooves unique to an individual much like fingerprints, footprints, and palm prints. Cheiloscopy, or the study of the grooves and wrinkles on the labial mucosa, helps classify, document, and evaluate lip print patterns. This article utilizes cheiloscopy to analyze students from the San Jose State University population; including 25 participants: 15 females and 10 males of ages between 18-45 years. Print collection utilized a matte lipstick, evenly applied on the lip, to create an impression using tape and white bond paper. Then, using the Suzui and Tsuchihashi method, researchers classified the lip prints. Observations indicate common occurrence of Type III is commonly seen in females (60%), and Type I in males (55%).

Keywords

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Lip prints have distinct forms of wrinkles and grooves unique to an individual much like fingerprints, footprints, and palm prints. Cheiloscopy, or the study of the grooves and wrinkles on the labial mucosa, helps classify is document, and evaluate lip print patterns. This article utilizes cheiloscopy to analyze students from the San Jose State University population; including 25 participants: 15 females and 10 males of ages between 18-45 years. Print collection utilized a matte lipstick, evenly applied on the lip, to create, an impression using tape and white bond paper. Then, using the Suzui and Tsuchihashi method, researchers classified the lip prints. Observations indicate common occurrence of Type III is commonly seen in females (60%), and Type I in males (55%).

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Introduction

According to Locard's Exchange Principle, when two objects come into contact, there will always be a trace of material from each other. This concept is fundamental for crime scene investigation; the exchange of material may consist of fibers, shoe prints, or even fingerprints. However, a type of evidence rarely analyzed is lip prints. Lip prints raise debates due to potential significance in personal identification. Many scientists argue lip prints have distinct forms of wrinkles and grooves unique to an individual much like fingerprints, palm prints, and footprints (Ludwig & Page, 2012). For example, the areas outlined by these creases, which appear dark on lip prints, are similar to the furrows and ridges of friction ridge skin (Ludwig & Page, 2012). Therefore, lip prints help in personal identification in both the field of forensic science. One of the methods of identification is cheiloscopy, which is the study of the wrinkles and grooves on the labial mucosa. Wrinkles and grooves appear as distinct patterns unique to each individual and do not change during a person's life (Ludwig & Page, 2012).

A study conducted by Dineshshankar and colleagues (2013) clarified that lip prints stay uniform throughout life but can change in terms of trauma and inflammation depending on environmental factors. This phenomenon was first noticed in 1902 by Fischer (Kasprzak, 1990). In 1932, Locard recommended using lip prints in crime scene investigations (Thomas & VanWyk, 1988). In 1960, Santos suggested use of lip characteristics for personal identification and created a system for classifying lip prints (Kasprzak, 1990). Equally important, scientists Yasuo Tsuchihashi and Kazuo Suzuki began studying lip prints extensively between 1968 and 1971 (Suzuki & Tsuchihashi, 1970). During this period, these scientists contributed the finding

that no two lip prints manifested the same pattern. Their research created a classification system called the Suzuki and Tsuchihashi lip print classification (Table 1). The classifications are as follows:

Table 1: ***Suzuki and Tsuchihashi Lip Print Classification***

Type	Description
Type I	A groove running vertically across the lip
Type I'	Partial length grooves of Type I
Type II	Branched grooves
Type III	Intersecting grooves
Type IV	Reticular Pattern
Type V	Any other patterns not following the previous patterns

Unlike fingerprint analysis, forensic science professionals do not widely accept the study of cheiloscopy as a personal identification. Although classifications exist, there are not enough scientific findings or research to unanimously support the methodologies for collection nor the concept of individualization for lip prints. However, research studies recommend that variations in lip patterns among males and females could help in sex determination. The purpose of this study is to classify and document lip print patterns among males and females in the San Jose State University population. Further, this study evaluates the

frequency of lip print patterns using a quadrant system and assesses any differences between the sexes and age groups.

Materials and Methods

The sample for this research consisted of 25 students at San Jose State University —15 females and 10 males —ages 18-45. Before taking an individual's lip print, researchers examined each subject's lips for any deformities, scars, or chapped lips. The study excluded any participants with signs of deformities, scars, or chapped lips. The exclusion of these participants served to avoid incorrectly classifying lip types. Participants provided any relevant allergies to lipsticks or cosmetic products, and informed researchers of sole use of vegan products to avoid potential allergic reactions and respect those against using animal products.

Before taking impressions, researchers attempted numerous methods of recording lip prints. This trial process sought to diminish the possibilities of errors when taking the final lip impressions. First, tissue paper removed any previous residues on the lips, including Chapstick, saliva, or food oils, from the subject's lips. Next, a deep brown matte lipstick was applied evenly using disposable eyeshadow applicators, starting from the midline and moving horizontally. The participants rolled their lips in order to evenly distribute the lipstick. Afterward, the lipstick dried for one minute. Finally, an impression was made on cellophane tape and transferred to a white bond paper. Three repetitions of the process ensured enough samples to analyzed. The participant's name, sex, and age was noted for each sample.

Researchers classified each individual's lip prints using the Suzuki & Tsuchihashi Classification of Lip Prints. Each print was measured for its length and divided into four equal quadrants as follows: Upper Left Quadrant (ULQ), Upper Right Quadrant (URQ), Lower Left Quadrant (LLQ), and Lower Right Quadrant

(LRQ).Then, all lip prints were scanned and formatted into a PDF file with notation of the pattern in each quadrant. All the data were entered in Microsoft Excel and presented as frequency and percentages. All the lip prints were compiled and analyzed by one examiner twice with 72 hours between each analysis.

Results

As previously mentioned, lip print impressions were obtained from both females and males. In addition, they were classified using the Suzuki & Tsuchihashi Classification of Lip Prints. The distribution of various lip print types in females and males in all quadrants are summarized and compared, illustrated in Tables 2 through 5.

Upper Left Quadrant

Type I pattern was observed in 6.6% of females and 50% of males. Type I' pattern was observed in 6.6% of females and 20% of males. Type II pattern was observed in 6.6% of females and 30% of males. Type III pattern was observed in 60% of females and 40% of males. Type IV pattern was observed in 33.3% of females and 20% of males. Lastly, Type V did not occur among females in this quadrant. However, it appeared in 20% of males.

Table 2: ***Upper Left Quadrant Lip Print Patterns***

Type	Sex	Count	Percent by Gender
Type I	**Female**	1	6.67%
	Male	5	50%
Type I'	**Female**	1	6.67%
	Male	2	20%
Type II	**Female**	1	6.67%
	Male	3	30%
Type III	**Female**	9	60%
	Male	4	40%
Type IV	**Female**	5	33.33%
	Male	2	20%
Type V	**Female**	0	0%
	Male	2	20%

Upper Right Quadrant

Type I pattern did not occur among females in this quadrant. However, it appeared in 60% of males. Type I' pattern was observed in 13.3% of females and 10% of males. Type II pattern was observed in 20% of females and 20% of males. Type III pattern was observed in 60% of females and 40% of males. Type

IV pattern was observed in 33.3% of females and 20% of males. Lastly, Type V did not occur among females in this quadrant. However, it appeared in 30% of males.

Table 3: ***Upper Right Quadrant Lip Print Patterns***

Type	Sex	Count	Percent by Gender
Type I	**Female**	0	0%
	Male	6	60%
Type I'	**Female**	2	13.33%
	Male	1	10%
Type II	**Female**	3	20%
	Male	2	20%
Type III	**Female**	9	60%
	Male	4	40%
Type IV	**Female**	5	33.33%
	Male	2	20%
Type V	**Female**	0	0%
	Male	3	30%

Lower Left Quadrant

Type I pattern was observed in 20% of females and 60% of males. Type I' pattern was observed in 13.3% of females and 10% of males. Type II pattern was observed in 40% of females and 20% of males. Type III pattern was observed in 60% of females and 30% of males. Type IV pattern was observed in 53.3% of females and 30% of males. Lastly, Type V did not occur among females in this quadrant. However, it appeared in 40% of males.

Table 4: ***Lower Left Quadrant Lip Print Patterns***

Type	Sex	Count	Percent by Gender
Type I	**Female**	3	20%
	Male	6	60%
Type I'	**Female**	2	13.33%
	Male	1	10%
Type II	**Female**	6	40%
	Male	2	20%
Type III	**Female**	6	40%
	Male	3	30%
Type IV	**Female**	8	53.33%
	Male	3	20%
Type V	**Female**	0	0%
	Male	4	40%

Lower Right Quadrant

Type I pattern was observed in 20% of females and 50% of males. Type I' pattern was observed in 13.3% of females and 10% of males. Type II pattern was observed in 33.3% of females and 20% of males. Type III pattern was observed in 46.6% of females and 30% of males. Type IV pattern was observed in 53.3% of

females and 30% of males. Lastly, Type V did not occur among females in this quadrant. However, it appeared in 30% of males.

Table 5: ***Lower Right Quadrant Lip Print Patterns***

Type	Sex	Count	Percent by Gender
Type I	**Female**	3	20%
	Male	5	50%
Type I'	**Female**	2	13.33%
	Male	1	10%
Type II	**Female**	5	33.33%
	Male	2	20%
Type III	**Female**	7	46.67%
	Male	3	30%
Type IV	**Female**	8	53.33%
	Male	3	30%
Type V	**Female**	0	0%
	Male	3	30%

Discussion

Personal identification is essential for identifying an unknown deceased person in a homicide, suicide, or mass disaster.

Potentially, well taken impressions of individuals' lips may serve as an antemortem record for matching details of lip prints in postmortem records for identification (Saraswathi, Gauri, & Ranganathan, 2009). Lip prints have similar, individual characteristics, just like fingerprints. Although the use of lip prints in a criminal investigation is minimal, it does have the potential for credibility with present and future studies. A lip print found may indicate someone's presence at the scene, the possible number of people involved, and the sex of the participants. However, a problem that forensic science professionals may encounter is the smudging of lip impressions. Unfortunately, that is a factor that is difficult to avoid unless victims or suspects use good quality lipstick.

This study's goal is to classify and study the common lip patterns and their variations in the sample population, and evaluate the differences between the sexes. Participants with chapped lips, trauma, deformities, or scars were excluded from the study since those features make it difficult to determine the lip pattern type. However, these irregularities serve as identification marks since the grooves and wrinkles do not change during a person's life.

A study by Vahanwala-Parekh in India suggests that Type I & I' are commonly found in females, whereas Type IV was seen more often in males (Sharma et al., 2009). This present study showed otherwise. Type III was seen in 60% of females, and Type I was seen in 50% to 60% of males. It can be argued that different populations in the world have different frequencies of lip pattern types. It can also be understood that the environment plays a significant factor in those characteristics. The present study also proves that cheiloscopy holds the potential to identify sex and personal identification.

Conclusion

The present study concluded that cheiloscopy has the potential to identify sex and an individual since lip prints remain the same over time. First, no two individuals in the studied group had an exact matching type in all four quadrants. Lip prints have good potential for use in a criminal investigation due to its level of individualization. This study included participants who happened to be identical twins. After analyzing their lip prints, it was noted that the lip prints did not have the same patterns. Cheiloscopy can be used as a tool to identify the sex of an individual as well. Depending on the population, there is a common type observed in both females and males. For the San Jose State community, Type III was commonly seen in females, followed by Type IV. At times, these two types were difficult to differentiate (Ahuja & Manchanda, 2009). Another observation was that Type I was commonly seen in males.

The technique used in this study for collection of the lip prints can be adopted as an excellent technique to obtain a definable lip print. However, research should develop a standard procedure to collect, classify, and compare between lip print types. Regarding classification, a study should be conducted to differentiate Type III and Type IV better, since they are similar. Perhaps showing different exemplars that are classified under Type III or Type IV would provide a more accurate classification. In addition, future studies replicating this research with larger sample sizes will provide more accurate mean values, identify outliers, and provide a lower margin of error..

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Daniela Zopiyatle graduated with her bachelor's degree in Forensic Science with a Concentration in Chemistry from San Jose State University in 2019. She is currently working in SJSU's IT Division where she is a Technology Coordinator. Although her passion is Forensics, she is also very passionate about Social Justice. In her post-grad life, she enjoys photography and being outdoors. In the future, she hopes to obtain a master's degree in Forensics or Chemistry.